



## Subject card

Subject name and code	Machine Learning II, PG_00060110						
Field of study	Automation, Robotics and Control Systems						
Date of commencement of studies	February 2022	Academic year of realisation of subject			2022/2023		
Education level	second-cycle studies	Subject group					
Mode of study	Full-time studies	Mode of delivery			at the university		
Year of study	2	Language of instruction			Polish		
Semester of study	3	ECTS credits			3.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Katedra Inteligentnych Systemów Sterowania i Wspomagania Decyzji -> Faculty of Electrical and Control Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Michał Grochowski					
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	30.0	0.0	45
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	45		8.0		22.0	75
Subject objectives	The aim of the course is to familiarise students with a comprehensive knowledge of Machine Learning and to show its practical applications in widely understood automation, computer science and decision support systems. The issues and theoretical methods discussed during the lectures will be illustrated with examples of their practical use and ways of implementation. Selected issues will be implemented in practice during project classes. In order to carry out the classes, students will be provided with access to relevant IT tools and data.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	K7_W05	Student designs and implements simple diagnostic systems. He uses selected methods of computational intelligence in the projects. He uses the software tool: Matlab, Python at an advanced level. On the basis of the conducted research, he knows how to draw conclusions.	[SW3] Assessment of knowledge contained in written work and projects
	K7_W11	The student, as part of a small team, is able to design, prepare and implement an experiment and then draw appropriate conclusions from it. For example, he/she can prepare a diagnostic system to detect breast cancer on medical images.	[SW3] Assessment of knowledge contained in written work and projects
	K7_U04	The student, in order to develop his/her own competences makes use of the state-of-the-art. monographic literature, databases publication databases (e.g. IEEE, Elsevier), courses (e.g. Coursera), or repositories such as Github.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject
	K7_U07	The student is able to apply artificial intelligence tools and algorithms to solve research problems, e.g. to design a neural classifier.	[SU4] Assessment of ability to use methods and tools
	K7_U06	Student examines the behaviour of dynamic objects by simulation and experiment; -Student selects the appropriate analytical and simulation methods to solve tasks in the field of control engineering and robotics;	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
	K7_U03	The student, on the basis of tests carried out, is able to process the results using using appropriate measures and indicators, is able to draw draw conclusions and present the results of experiments and analyses in in an understandable form.	[SU5] Assessment of ability to present the results of task [SU2] Assessment of ability to analyse information
Subject contents	<p>The content will be delivered within three thematic blocks:</p> <ol style="list-style-type: none"> <li>1. Deep learning models and systems, including: VGG, ResNet, EfficientNet, Multiple Instance Learning DNN, Clustering-constrained Attention MIL (CLAM), Dual Stream Multiple Instance Learning DNN, Attention-based MIL (ABMIL), YOLO DNN.</li> <li>2. Deep learning issues, including: classification, detection, segmentation.</li> <li>3. Advanced methods for training deep neural networks, e.g.: Self-supervised learning, weakly-supervised learning, unsupervised learning, contrastive learning.</li> <li>4 Model performance analysis and technologies to support neural networks models training, eg: - measures of model performance quality, regularisation techniques, selection of model hyperparameters, analysis of algorithm performance using explanatory artificial intelligence (XAI).</li> </ol>		
Prerequisites and co-requisites	Participation in the course Machine learning I		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Project	50.0%	75.0%
	Lecture	50.0%	25.0%

Recommended reading	Basic literature	<ul style="list-style-type: none"> <li>• Bonaccorso, G. Algorytmy uczenia maszynowego. Zaawansowane techniki implementacji. Helion, 2019</li> <li>• Szeliga, M. Data Science i uczenie maszynowe. Wydawnictwo Naukowe PWN, 2017.</li> <li>• Grus, J. Data science od podstaw. Analiza danych w Pythonie. Helion, 2019.</li> <li>• Bengio, Y., Courville A., Goodfellow I. Deep Learning. Systemy uczące się. Wydawnictwo Naukowe PWN, 2018.</li> <li>• Alpaydin, E. Introduction to Machine Learning. The MIT Press Cambridge, Massachusetts London, England 2010.</li> <li>• Chollet, F. Deep Learning. Helion, 2019</li> </ul>
	Supplementary literature	<ul style="list-style-type: none"> <li>• Haykin, S. Neural Networks and Learning Machines (3rd Edition), Prentice Hall, 2009.</li> <li>• Bishop C. M. Pattern Recognition and Machine Learning. Springer, 2006.</li> <li>• MATLAB Statistics and Machine Learning Toolbox User's Guide, 2021.</li> <li>• James, Gareth, et al. An introduction to statistical learning. Vol. 112. New York: springer, 2013.</li> <li>• Murphy, Kevin P. Machine learning: a probabilistic perspective. MIT press, 2012.</li> </ul>
	eResources addresses	
Example issues/ example questions/ tasks being completed	<p>Synthesis and training of neural models under scarcity of training data.</p> <p>Post-hoc analysis of neural model performance (XAI techniques)</p>	
Work placement	Not applicable	